BIOENGINEERING SCIENCES & TECHNOLOGIES [BST] GUIDELINES

The Bioengineering Sciences and Technologies (BST) IRG will review grant applications that focus on fundamental aspects of bioengineering and technology development in the following areas: gene and drug delivery systems, imaging principles for molecules and cells, modeling of biological systems, bioinformatics and computer science, statistics and data management, instrumentation, chips and microarrays, biosensors, and biomaterials. While biological context is important in bioengineering, a central premise in organizing this IRG is the need for effective review of bioengineering and technology development in early stages before specific practical uses are proven.

The following study sections, each of which would review research project grant (R01, R21, R15, etc.) and Small Business and Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grant applications, are recommended for inclusion in the BST IRG:

Gene and Drug Delivery Systems (GDD)
Microscopic Imaging (MI)
Modeling and Analysis of Biological Systems (MABS)
Biodata Management and Analysis (BDMA)
Instrumentation and Systems Development (ISD)
Biomaterials and Biointerfaces (BMBI)

The study sections of the Bioengineering Sciences and Technologies IRG are among the first of the new or reorganized study sections to be proposed for implementation. As a result, some of the Teams that will develop recommendations for other IRGs that may share interests in areas of research with the BST IRG have not yet met or completed their deliberations. Therefore, the proposed “shared interest” guidelines for each of the study sections listed below are tentative, pending further input from the remaining study section design Teams, the scientific community, and the CSR Advisory Committee to the Director, CSR.

Gene and Drug Delivery Systems Study Section (GDD)

The Gene and Drug Delivery Systems (GDD) study section will consider grant applications (R01, R21, SBIR/STTR, etc.) focused on the development and delivery of drugs, genes, and gene products that alter gene function or expression in the living organism. Research grant applications driven by bioengineering principle, design, or validation, not necessarily driven by hypothesis, are expected. Areas include the use of new strategies and tools to alter gene function or expression:

- Agents delivered: Includes DNA, RNA, RNA interference (RNAi), antisense oligonucleotides, large and small insert vectors, aptamers, peptide nucleic acids (PNAs), small molecule activators and inhibitors, antibiotics, vaccines, peptides, proteins, cells, and other drugs.

- Vehicles: Includes viral and other vectors, liposomes, polyethylene glycol (PEG), and lipid-based transfection agents.

- Delivery strategies: Includes electroporation, ultrasound, receptor mediated translocation, opto-injection, ballistic methods, vesicles, and viral agents.

- Gene regulation of active agents: Includes enhancers and silencers, tissue specificity, external control, nuclear vs. cytoplasmic localization, and targeted integration.

- Expression patterns: Includes tissue and cellular localization, markers for expression, copy number, transcriptional and translational products, and activity-dependent probes.

GDD: Shared Interests Within IRG

- Microscopic Imaging (MI): The GDD study section shares interests with the MI study section in the areas of cellular imaging as a readout, e.g., activity dependent probes, expression patterns, interaction probes, single molecule reporters. Normally, applications focusing on imaging technology and development will be assigned to MI.
- Instrumentation and Systems Development (ISD): GDD shares interests with the ISD study section in the area of instruments for gene and drug delivery. Applications on nano or microfabricated delivery vehicles and ballistic methods could be assigned to GDD.
- Modeling and Analysis of Biological Systems (MABS): GDD shares interests with the MABS study section in the area of gene regulatory networks and metabolic pathways and studies to perturb individual genes or regulatory factors. Applications on systems biology could be assigned to MABS.
- Biomaterials and Biointerfaces (BMBI): GDD shares interests with the BMBI study section. Fabrication and synthesis of biomaterials, monitoring of release kinetics and pharmacodynamics, and biomaterials for gene transfer could be assigned to BMBI.

GDD: Shared Interests Outside IRG

- Biological Chemistry and Macromolecular Biophysics (BCMB), Molecular Approaches to Cell Function and Interactions (MACFI), and Biology of Development and Aging (BDA): Grant applications focused on basic biological mechanisms are relevant to the indicated IRGs. Applications focused on the design, development, and introduction of technology in support of gene, drug, and cell delivery are relevant to BST and the GDD study section.

- Genes, Genomes, and Genetics (GGG): The GGG IRG has substantial shared interests with GDD. Applications addressing research questions that are linked to genetic problems could be reviewed by the GGG IRG, whereas applications that are more broadly technology oriented or where application is not specified could be reviewed by GDD.

- Health of the Population, Risk, Prevention and Health Behavior, and Biobehavioral and Behavioral Processes: These IRGs share basic interests with GDD. Grant applications focused on basic health behavior and behavior genetics are relevant to the indicated IRGs. Grant applications focused on the design, development, and introduction of technology in support of gene and drug delivery are relevant to BST and the GDD study section.

- Immunology (IMM): The IMM IRG shares basic interests with GDD. Grant applications focused on basic immunological mechanisms could be assigned to IMM. Grant applications focused on the design and development of technology in support of gene and drug delivery, and development of delivery strategies based on antibodies, could be assigned to BST and the GDD study section.

- Infectious Diseases and Microbiology (IDM) and AIDS and Related Research (AARR): These IRGs share infectious disease and virology interests with GDD. Grant applications focused on infectious diseases and virology mechanisms, including diagnostics, vaccines, and delivery mechanisms, could be assigned to either IDM or AIDS. Applications focused on developing technologies to introduce genes and drugs in a basic virology context or developing viral vectors for delivery could be assigned to BST and the GDD study section.

- Oncological Sciences; Hematology; Cardiovascular Sciences; Endocrinology, Metabolism, Nutrition, and Reproductive Sciences; Musculoskeletal, Oral, and Skin Sciences; Digestive Sciences; Respiratory Sciences; and Renal and Urological Sciences: These IRGs share organ/disease interests with GDD. Grant applications focused on organ/disease specific biological mechanisms and therapies could be assigned to the organ/disease indicated IRG. Applications focused on basic or developing technologies to introduce genes and drugs in a general cellular context could be assigned to BST and the GDD study section.

- Surgical Sciences, Biomedical Imaging and Bioengineering (SBIB): SBIB shares interests with GDD in the delivery of drugs, genes, and gene products. Development of delivery techniques could be reviewed in SBIB if the objective of the study is to address questions of either diagnosis or pathology. If the study objective is to address questions of basic delivery techniques, or techniques for which specific applications are not defined, review could be in GDD.

- Molecular, Cellular, and Developmental Neuroscience; Integrative, Functional, and Cognitive Neuroscience; and Brain Disorders and Clinical Neuroscience: These IRGs share neuroscience interests with GDD. Grant applications focused on neuroscientific mechanisms could be assigned to the indicated IRGs. Applications focused on the design, development, and introduction of technology in support of gene and drug delivery in nervous systems could be assigned to BST and the GDD study section.

Microscopic Imaging Study Section (MI)

The Microscopic Imaging (MI) study section reviews applications (R01, R21, SBIR/STTR, etc.) that aim to develop, improve and implement quantitative techniques for the static and dynamic visualization of molecules, macromolecular machines and complexes, organelles, cells, and model systems in physiologically active states. Large animal and human studies will not be considered in MI. Examples of methodologies relevant to MI include crystallography, TEM (transmission electron microscopy), electron cryomicroscopy, SEM (scanning electron microscopy), ESEM (environmental scanning electron microscopy), AFM (atomic force microscopy), SFM (scanning force microscopy), fluorescence microscopy and laser spectroscopy including microarray/chip analysis, confocal and scanning light microscopy, vibrational spectroscopic microscopy, multi-photon microscopy, x-ray microscopy, acoustic microscopy, NMR (nuclear magnetic resonance) and microscopic applications of MRI (magnetic resonance imaging). Imaging principles or instruments may be developed, and proposals need not be hypothesis-driven.

Areas covered by MI include:

- Development and Improvement of Instrumentation: major microscopic devices and accessories such as specimen holders and environmental chambers for molecules or assemblies or living cells, high resolution and large pixel detectors, high-resolution film

scanners, specimen preparative apparatus, computer automation of data collection and remote access.

- Improvement of Specimen Preparation Methodology: crystallization of membrane proteins and large assemblies, chemical and cryo specimen preservations, non-invasive preparative methods, chemical agents for contrast enhancement, molecular tagging, cell labeling, genetically expressed labels and studies of chemical and radiation damage effects.

- Image Analysis: Validation of image formation theory, data management, phasing methods, algorithm development including filtering, signal detection, data reduction, image enhancement, pattern recognition, restoration, reconstruction, segmentation, feature extraction, visualization of multi-dimensional information, and high throughput, automatic data processing when the purpose of study is basic research and development or molecular biology.

- Data mining: Integration of information derived from complementary imaging techniques and bioinformatics to derive functional mechanisms.

Shared interests within the IRG:

- Gene and Drug Delivery Systems (GDD): MI shares interests with the GDD study section in the areas of cellular imaging as a readout, e.g., activity dependent probes, expression patterns, interaction probes, single molecule reporters. Applications that focus on the delivery vehicle could be assigned to GDD. Applications focusing on imaging technology and development could be assigned to MI.

- Instrumentation and Systems Development (ISD): MI shares interests with the ISD study section. If the focus is on the instrument per se then assignment could be to ISD. If the focus is on imaging data analysis, then MI could be the appropriate home for review.

- Biodata Management and Analysis (BDMA): MI shares interests with the BDMA study section. If the focus is on image archiving then BDMA may be the appropriate home. However, if the focus in on generation of images, then MI may be the appropriate home for review.

- Biomaterials and Biointerfaces (BMBI): MI shares interests with the BMBI study section in development of new materials for use as image enhancers and contrast agents. MI may review applications emphasizing small molecule and soluble contrast agents; whereas BMBI may review applications emphasizing development of new polymeric or nanoparticle based contrast agents or where materials synthesis, characterization, biocompatibility, and toxicity are prominent.

Shared interests outside the IRG:

- Biological Chemistry and Macromolecular Biophysics (BCMB): Potential shared interests are with Biological Chemistry and Macromolecular Biophysics IRG, which generally concern specific biological/chemical systems whereas the proposed MI is focused on general methodology and technology. Applications focusing on synthesis of imaging

agents could be assigned to BCMB; applications focusing on application of agents to new imaging approaches could be assigned to MI.

- Genes, Genomes, & Genetics (GGG): An area of shared interest may be molecular image analysis, e.g., of fluorescence in situ hybridization (FISH) datasets or microarray/chip datasets. Applications addressing research questions that are linked to genetic problems could be reviewed by the GGG IRG, whereas molecular imaging proposals that are more technology oriented or where application is not specified could be reviewed by MI.

- Molecular Approaches to Cell Function & Interactions (MACFI): High throughput cell imaging studies would be an area of shared interest. Applications addressing research questions related to cell biology could be assigned to the MACFI IRG; applications addressing the technology of high throughput cell imaging could be assigned to MI.

- Infectious Diseases & Microbiology (IDM) and AIDS & Related Research (AARR): The IDM and AARR IRGs share infectious disease, virology, and related interests with MI. Applications focused on research questions related to infectious disease and virology could be assigned to IDM or AARR; applications focused on technology necessary for molecular or cellular imaging of microbes could be assigned to MI.

- Oncological Sciences (ONC): Radiation damage is possibly a shared interest. Radiation damage due to therapeutic radiation could be assigned to ONC. Radiation damage due to specimen analysis could be referred to MI.

- Surgical Sciences, Biomedical Imaging and Bioengineering (SBIB): Shared interests are expected in development of instrumentation, techniques, and procedures for imaging molecules and organelles with study sections in SBIB. If the objective of the study is to address questions of diagnosis, pathology, or treatment, assignment could be to SBIB, e.g., contrast agents for medical imaging could be assigned to SBIB. If the study objective is to address questions of either mechanism or basic biology, assignment could be to MI, e.g., contrast agents for microscopic imaging could be assigned to MI. MI typically will not review applications involved with large animals and human subjects.

Modeling and Analysis of Biological Systems Study Section (MABS)

The Modeling and Analysis of Biological Systems (MABS) study section will review applications (R01, R21, SBIR/STTR, etc.) that develop modeling/enabling technologies for understanding the complexity of biological systems. Research grant applications driven by bioengineering principle, design, or validation, not necessarily driven by hypothesis, are expected. The scope of interactions reviewed here ranges from molecular to supramolecular and cellular in prokaryotic and eukaryotic cells, and to organelle and to tissue in eukaryotic systems. For these applications, the integration of interactions through levels and scales and the emergence of patterns that help to explain system behavior are the ultimate goals for applying these tools.

Specific areas covered by MABS:

- Modeling methods: Data integration into models; computational systems and tools for model construction, analysis, and simulation; sensitivity analysis; optimization techniques; dimensional analysis; structural analysis (topology); emergent properties of complex

systems; model visualization; in silico modeling; multiscale/multilevel modeling; and modeling of evolving and adaptive systems.

- Specific models of important processes: signal transduction; biochemical networks; gene regulatory networks; metabolic networks; computer simulations; intracellular dynamics; cell structural dynamics; analysis of large datasets.

- Integration of modeling and experiment: experimental validation of models; tools for analysis of assemblies, complexes, and networks; cell and molecular interactions; network reconstruction; high-throughput data integration; combinatorial approaches to genomics, proteomics and glycomics data.

- Development and adaptation of mathematical methods: stochastic, Boolean, continuous; dynamical systems analysis; timescale and spatial decomposition; stiff systems; sparse systems; finite difference and finite element approaches to spatial modeling.

Shared interests within the IRG:

- Biodata Management and Analysis (BDMA): MABS shares interests with the BDMA study section in the areas of bioinformatics and large-scale data collection efforts or "–omics" applications (genomics, proteomics, metabolomics, etc.). If the focus is modeling or computer simulations, review by MABS would be appropriate. If the focus is large-scale data analysis, then BDMA would be appropriate.

- Instrumentation and Systems Development (ISD): MABS shares interests with the ISD study section in the area of high throughput technologies. If the focus is modeling, review by MABS would be appropriate. If the focus is high throughput instrumentation, then ISD would be appropriate.

Shared Interests outside the IRG:

- Biological Chemistry and Macromolecular Biophysics (BCMB); Molecular Approaches to Cell Function and Interactions (MACFI); Biology of Development and Aging (BDA): MABS shares computational modeling interests with BCMB, MACFI, and BDA. If the focus is experimental investigation of chemical or biophysical interactions among molecules, cell physiological processes, development, differentiation, or signal transduction, then review by the IRGs identified could be appropriate. If the primary focus is development of technology for computational modeling or development of methods for combining modeling or related analyses, review by MABS could be appropriate.

- Genes, Genomes, and Genetics (GGG): MABS shares interests with the GGG IRG. If the focus is experimental investigation of questions related to regulation of gene expression or genomics, review by GGG could be appropriate. However, if the primary focus is modeling technology or related analyses, review by MABS could be appropriate.

- Infectious Diseases & Microbiology (IDM) and AIDS & Related Research (AARR): IDM and AARR share infectious disease, virology, and related interests with MABS. If the scientific focus is application of existing modeling paradigms to microbes, assignment to IDM or AARR could be appropriate; if the scientific focus is development of new modeling

paradigms for microbes or related computational analyses, assignment to MABS could be appropriate.

- Oncological Sciences (ONC): MABS shares interests with ONC, where review could be appropriate if cancer cell physiology, signal transduction, or therapy is the focus. If the focus is modeling or related analyses, then review by MABS could be appropriate.

- Surgical Sciences, Biomedical Imaging and Bioengineering (SBIB): MABS shares interests with SBIB in the areas of biological and medical computing and informatics as related to modeling physiological function. If the objective of the study is to address questions of diagnosis, pathology, or therapy, assignment could be to SBIB. If the objective of the study is to address questions of basic biology, modeling, or simulation, assignment could be to MABS.

Biodata Management and Analysis Study Section (BDMA)

The Biodata Management and Analysis (BDMA) study section will review applications (R01, R21, SBIR/STTR, etc.) that aim to develop technologies for the management and analysis of basic biological data, i.e., bioinformatics, computational biology, and computer science. This includes the review of data management technology in support of large-scale data collection and integration efforts. Research grant applications driven by bioengineering principle, design, or validation, not necessarily driven by hypothesis, are expected.

Specific areas covered by the BDMA study section include:

- Methods for data management including: Data representation, standards and ontology development, data capture, data integrity and validation, data archiving, data distribution, data query, hardware and software for computer systems, database robotics, and interoperation and federation of databases.

- Methods for data analysis including: Numerical, statistical and mathematical methods; theoretical approaches to design and interpretation of large-scale studies, such as high throughput analyses; computational methods for organizing, maintaining, and integrating datasets, such as in proteomics and genomics.

- Visualization techniques: Summary, integration, and representation of data in meaningful ways, for example, graphical, auditory, tactile, and visual; methods for data mining, World Wide Web and other server representations and computer representations and simulations.

BDMA: Shared Interests Within IRG

Most of the study sections in this IRG will involve at some level the management of data generated by their projects. The BDMA study section focuses on basic methodology for data management and would be the appropriate home when that is the central scientific question. Specifically, the following shared interests merit highlighting:

- Microscopic Imaging (MI): BDMA shares interests with the MI study section in the imaging area. If the focus in on generation of images, then MI would be the appropriate home for

review; however, if the focus is on image archiving, then BDMA would be the appropriate home.

- Modeling and Analysis of Biological Systems (MABS): BDMA shares interests with the MABS study section in the areas of bioinformatics and large scale data collection efforts or "–omics" applications (genomics, proteomics, metabolomics, etc.). If the focus were large-scale data analysis, then BDMA would be appropriate. If the focus were modeling, review by MABS would be appropriate.

- Instrumentation and Systems Development (ISD): BDMA has shared interests with the ISD study section in areas of data acquisition, analysis software, and hardware. If the focus were data storage and manipulation, then BDMA would be appropriate. If the focus were hardware or instruments for data collection, then ISD would be appropriate.

BDMA: Shared Interests With Other IRGs

- Biological Chemistry and Macromolecular Biophysics (BCMB); Molecular Approaches to Cell Function and Interactions (MACFI); Biology of Development and Aging (BDA): BDMA shares computational and database interests with BCMB, MACFI, and BDA. If the focus is use of computational or database tools for analysis of chemical or biophysical interactions among molecules, cell physiological processes, development, differentiation, or signal transduction, then review by the IRGs identified could be appropriate. If the primary focus is development of computational or database tools, review by BDMA could be appropriate.

- Genes, Genomes, and Genetics (GGG): BDMA shares computational and database interests with the GGG IRG. If the focus is experimental or computational investigation of questions related to genetics, regulation of gene expression, or genomics, review by GGG could be appropriate. However, if the primary focus is developing database technology, related computational analyses, or statistical methods for analyzing data, including genetic/genomic data, review by BDMA could be appropriate.

- Health of the Population (HOP): BDMA and HOP share interest in statistical methods applications. Specifically, HOP reviews applications related to population processes, composition and distribution, and the development and validation of methodologies for population research, including measurement, design, and statistical analysis. Other statistical methodology applications could be reviewed by BDMA.

- Infectious Diseases & Microbiology (IDM) and AIDS & Related Research (AARR): IDM and AARR share infectious disease, virology, and related interests with BDMA. If the focus is experimental or computational investigation of questions related to microbes, assignment to IDM or AARR could be appropriate; if the focus is developing database technology, related computational analyses, or statistical methods for analyzing data, including infectious disease and virology data, assignment to BDMA could be appropriate.

- Surgical Sciences, Biomedical Imaging and Bioengineering (SBIB): BDMA shares interests with SBIB in the area of management of biological and medical data. If the objective of the study is to address questions of diagnosis, pathology, treatment, or medical data management, assignment could be to SBIB. If the objective of the study is to address questions of basic data management or biology, assignment could be to BDMA.

Instrumentation and Systems Development Study Section (ISD)

The Instrumentation and Systems Development (ISD) study section will consider research applications (R01, R21, SBIR/STTR, etc.) seeking to design and develop novel instrumentation and systems for biological research. Although a test biological problem may be used to provide context, proposals to this study section need not necessarily be hypothesis driven. Specific areas of interest include:

- Analytical instrumentation: The design and development of novel instrumentation for biological research. Examples are mass spectrometry, magnetic resonance spectroscopy, x-ray, neutron and electron crystallography, solution scattering, and 2D and 3D imaging technologies for fluorescence, scanning tunneling microscopy, atomic force microscopy, electron microscopy, vibrational spectroscopic microscopy, x-ray photoelectron spectroscopy, and hardware and computer systems.

- Sensing devices: Approaches to the detection and quantification of biologically important molecules, including both small molecule and macromolecular species. The development of such devices may require new surface chemistries and chemical, electrical, or other detection modalities, and may range in scope from devices for the analysis of a single analyte species to devices for the parallel analysis of thousand or millions of species. In addition, sensors of endogenous electric and magnetic fields in biological systems are of interest.

- Separation technologies: Improvements and variations to classical techniques such as electrophoresis and chromatography, as well as the exploration and development of novel approaches, including molecule, assembly, and cell separations, microfluidics, and nanotechnology.

- Robotics and automation: The design and development of both individual instrumentation modules and integrated robotic systems for the automation of chemical or biological reactions or processes. Systems for the large-scale acquisition of multivariate information from biological systems of interest.

- Synthesis: Instruments for the synthesis of biomolecules at various scales.

- Micro/nanofabrication: Microfabricated and/or nanostructured devices and systems for use in biological research.

- Single molecule/cell approaches: Techniques, approaches, and devices for the analysis of biological systems at the single molecule, assembly, or single cell level.

ISD: Shared Interests Within IRG

Many of the study sections in this IRG will involve instrumentation at some level. With a focus on design and development of instrumentation and methods of analysis, the ISD study section would be the appropriate home when that is the central scientific or bioengineering question. Specifically, the following shared interests merit highlighting:

- Gene and Drug Delivery Systems (GDD): ISD shares interests with the GDD study section in the area of instruments for gene and drug delivery. Applications on nano or microfabricated delivery vehicles and ballistic methods could be assigned to GDD. Design and development of instrumentation to deliver samples and to monitor delivery could be reviewed by ISD.

- Microscopic Imaging (MI): ISD shares imaging interests with the MI study section. If the focus is on the design or development of imaging instrumentation per se then ISD may be the appropriate home. If the focus is on imaging data analysis then MI may be the appropriate home for review.

- Modeling and Analysis of Biological Systems (MABS): ISD shares interests with the MABS study section in the area of high throughput technologies. If the focus is modeling, review by MABS may be appropriate. If the focus is high throughput instrumentation, then ISD may be appropriate.

- Biodata Management and Analysis (BDMA): ISD has shared interests with the BDMA study section in the areas of data acquisition, analysis software, and hardware. If the focus is data storage and manipulation, then BDMA may be appropriate. If the focus is hardware or instruments for data collection, then ISD may be appropriate.

- Biomaterials and Biointerfaces (BMBI): ISD has shared interests with the BMBI study section in the areas of development of microarray and nanoscale technologies and in sensing devices and associated surface chemistries. Applications with a principal focus on the materials and surface chemistry may be directed to BMBI, whereas applications with a major emphasis on instrumentation for materials fabrication or use may be directed to ISD.

ISD: Shared Interests With Other IRGs

Multiple study sections in other IRGs will involve adaptation of instrumentation and analytical methods to specific biological, medical, or organ situations. If the focus is on the specific situation, then other IRGs may be appropriate. However, if the focus is on design or development of the basic instrument or analytical method ISD may be appropriate. Specific shared interests are:

- Biological Chemistry and Macromolecular Biophysics (BCMB): ISD shares interests with BCMB in the development and application of novel approaches for the study of molecular structure and interactions. In cases where the dominant emphasis of the application is the development of a novel technology or instrument, the application may be assigned to ISD within BST. In cases where the dominant emphasis of the application is the science to be done with the new technology, rather than the technology itself, the application may be assigned to BCMB.

- Molecular Approaches to Cell Function & Interactions (MACFI): Cell separations would be an area of shared interest. Applications addressing research questions related to cell biology could be assigned to the MACFI IRG; applications addressing the technology of cell separations could be assigned to ISD.

- Infectious Diseases & Microbiology (IDM) and AIDS and Related Research (AARR): IDM and AARR share interest in sensors with ISD. Grant applications focused on detecting infectious agents could be assigned to IDM or AARR. Applications focused on developing

detection technologies could be assigned to BST and the ISD study section, particularly if specific uses are unclear.

- Surgical Sciences, Biomedical Imaging, and Bioengineering (SBIB): ISD shares interests with SBIB in the development of biological instrumentation. If the objective of the study is to address development of instruments for understanding questions of diagnosis, pathology, or treatment, the proposal may be directed to SBIB. If the objective of the study is to address development of instruments for understanding questions of mechanism or basic biology, the proposal may be directed to ISD.

Biomaterials and Biointerfaces Study Section (BMBI)

The Biomaterials and Biointerfaces Study Section (BMBI) will review grant applications (R01, R21, SBIR/STTR, etc.) in materials science and the closely allied field of materials surfaces and their interactions with basic biological systems. The material aspects of biomaterials and surface science concern the design principles and theory and the synthesis, characterization, and optimization of new or existing materials including polymers, composites, metals, ceramics, nanomaterials, hybrid systems of natural and synthetic polymers, and biomimetics. The biological aspects of biomaterials science concern interactions of materials with proteins, cells, and tissues including studies related to scaffolds for tissue repair/tissue engineering, materials for bioreactors, biocompatibility issues, and microcirculation around implanted biomaterials. Grant applications concerned with biomaterials, biointerfaces, and biofunctional design usually are not hypothesis driven. Such research uses known fundamental principles or theory to discover new basic approaches useful for understanding biological phenomena.

Specific areas covered by BMBI include:

- Research and development of efficient methods to assess biocompatibility of materials including: Predictive, low-cost in vitro and in vivo models with a focus on reliability, accelerated testing, failure analysis, imaging, and improved understanding of the biology-biomaterials interface.

- Molecular/cellular interfacial interactions including: Protein adsorption, cell adhesion, differentiation and growth, biomolecule function at interfaces, nonfouling surfaces, and bioactive surfaces.

- New material development including: Design principles, synthesis of polymers, metals, ceramics, composites, glasses, carbons, biomimetic/bioinspired strategies for synthesis, structure-property relationships of biomaterials, bulk characterization of biomaterials, biodegradable and bioresorbable materials, material processing, and combinatorial approaches to synthesis of new biomaterials.

- Nanoscience and nanotechnology including: Nanoparticles, nanostructured surfaces, nanocomposites, nanodevices, and multifunctional nanoparticles.

- Biomaterials including: Biocompatibility, blood/material interactions, toxicity, structure/property relationships, and biodurability.

- Drug delivery systems including: Carrier materials, fabrication of micro-scale devices, and biocompatibility.

- Gene delivery systems including: Carrier materials, preparation of biomaterials, biocompatibility, and fabrication of delivery devices.

- Chip- and microarray-based microtechnology including: Patterning, immobilization chemistry, nonfouling chemistry, detection modalities, MEMS (micro-electro-mechanical systems), lithography, and microfluidics.

- Tissue engineering including: New biomaterials and fabrication techniques, cell-biomaterial interactions, transport and perfusion aspects of tissue engineering, bioreactors, cell and specific cell biology engineering, and tissue engineering.

- Self-assembled materials including: Block copolymers, surface assembly, protein assembly, biosignal delivery using self-assembled materials, biorecognition, liposomes, and tethered biomembrane mimics.

- Biosurface characterization and technology including: Surface analysis, surface modification, lubricity and tribology, and patterning.

- Biosensors including: Biorecognition, biocompatibility, nonfouling surfaces, and fouling mechanisms.

BMBI: Shared Interests Within the IRG

- Gene and Drug Delivery Systems (GDD): The GDD and BMBI study sections have shared interests in development and application of synthetic and biological materials for gene and drug delivery, including the incorporation of genetic material into bulk biomaterials, e.g., for enhancement of tissue engineering strategies. GDD could be assigned studies on gene vectors and drug delivery vehicles. BMBI could be assigned related studies emphasizing synthesis, physical characterization, biocompatibility, and toxicity of new synthetic materials intended for use as gene or drug delivery vehicles.

- Microscopic Imaging (MI): Both BMBI and MI study sections share an interest in development of new materials for use as image enhancers and contrast agents. BMBI may review applications emphasizing development of new polymeric or nanoparticle based contrast agents or where materials synthesis, characterization, biocompatibility, and toxicity are prominent, whereas the MI study section may review applications emphasizing small molecule and soluble contrast agents.

- Instrumentation and Systems Development (ISD): Both BMBI and ISD share interests in the areas of development of microarray and nanoscale technologies and in sensing devices and associated surface chemistries. Applications with a principal focus on the materials and surface chemistry may be directed to BMBI; whereas applications with major emphasis on instrumentation for materials fabrication or use may be directed to ISD.

BMBI: Outside the IRG

Common interests with other IRGs include:

- Biological Chemistry and Macromolecular Biophysics (BCMB); Genes, Genomes, and Genetics (GGG); Molecular Approaches to Cell Function and Interactions (MACFI); Biology of Development and Aging (BDA); Immunology (IMM); Infectious Diseases and Microbiology (IDM); AIDS & Related Research (AARR); Oncological Sciences (ONC); Hematology (HEME); Endocrinology, Metabolism, Nutrition, and Reproductive Sciences (EMNR); Digestive Sciences (DIG); Respiratory Sciences (RES); Renal and Urological Sciences (RUS); Molecular, Cellular, & Developmental Neuroscience (MDCN); Integrative, Functional, & Cognitive Neuroscience (IFCN); Brain Disorders and Clinical Neuroscience (BDCN): Biomaterials and biointerfaces are relevant to a wide variety of biological and medical devices that are utilized in biological, medical, and clinical applications. Therefore BMBI has extensive common interests with other IRGs. Where the issues involve research and development on new materials or biocompatibility, assignment may be to the BMBI study section. Where tissue integration and application to specific biological and medical devices and systems are primary foci, assignment to other IRGs, including SBIB, may be appropriate.

- Cardiovascular Sciences (CVS): The fundamental role of surfaces in triggering thrombosis and other blood and tissue reactions makes the focus of BMBI a significant component of the development of cardiovascular devices, including stents, heart valves, vascular grafts, artificial hearts, ventricular assist devices and others. Applications on such devices could be assigned to CVS (or SBIB). Basic research and development applications on materials and surfaces that might be used for such devices could be assigned to BMBI.

- Musculoskeletal, Oral and Skin Sciences (MOSS): Extensive use of medical implant materials in dental and orthopedic applications creates opportunities for synergism in studies on biocompatibility and new material development. Grant applications on dental and orthopedic implants could be assigned to MOSS. Basic research and development applications on materials and surfaces that might be used for such implants could be assigned to BMBI. As stated above, where tissue integration and application to specific medical devices and systems are the primary focus, assignment to IRG MOSS (or SBIB) may be appropriate.

- Surgical Sciences, Biomedical Imaging & Bioengineering (SBIB): Biomaterials, e.g., as in biosensors and tissue engineering, are shared interests between SBIB and BMBI. Basic research and development on biomaterials and biocompatibility may be reviewed in BMBI, whereas research and development on medical devices may be reviewed in SBIB.